mosaic particles. Approximately 70 to 80 per cent. of the particles have a length close to 3,000 Å; most of the remainder have a length between 750 and 2,250 Å. It is evident from these results that, if there is orientation in the third dimension, the characteristic spacing could be as great as 3,000 Å, a value too great to have been detected by the x-ray technique used by Bernal and Fankuchen.[8] Their x-ray results therefore can no longer be considered evidence against a 3-dimensional orientation of the particles. If there is orientation in the third dimension it would probably be much less perfect than in most crystals because of the variation in the length of the virus particles.

From the above discussion it is evident that our suggestion of a 3-dimensional orientation of tobacco mosaic particles is based on Langmuir's evidence that tilting of particles is dependent on a 3-dimensional arrangement. If the tilting is not dependent on a 3-dimensional arrangement but on other factors mentioned by various workers,[9] assumption of a 3-dimensional orientation of tobacco mosaic virus particles would be unfounded.

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[5] W. M. Stanley and Thomas F. Anderson, *Jour. Biol. Chem.*, 139: 325, 1941.

[6] T. E. Rawlins, SCIENCE, 96: 425, 1942.

[7] T. E. Rawlins and Nedra M. Utech. Unpublished results.

[8] J. D. Bernal and I. Fankuchen, *Jour. Gen. Physiol.*, 25: 111, 1941.

[9] J. T. Edsall, *Advances in Colloid Science*, 1: 269, 1942.

THE INCOMPLETENESS OF SOME ECOLOGICAL GRASSLAND STUDIES

As an ecological factor in pastures, the wild animal life, consisting mostly of small inconspicuous invertebrates, must at least be considered, even if it is thought not to equal in its effect the feeding of domestic animals, the competition of weeds or the vigor of the different species of the grasses themselves, and the physical environmental factors of topography, soil and climate. The neglect of this factor of the smaller wild animals may lead to serious errors. For, incredible as it may seem, in many a pasture grazed not too close to its carrying capacity, the obvious cows and horses are not as great a bulk as the total weight of insect and other wild animal life existing there. Ants and leafhoppers are especially numerous in grasslands, but because of their small size, the effect of their presence is not so marked as that of grasshoppers, cutworms and white grubs, which eat almost as much of the pasturage as do the domestic animals.[1] The statistical studies conducted on grasslands in England and of a considerable variety of environments elsewhere[2] have, unfortunately, not been carried far enough to show how much each species of insect, spider, millipede, snail, earthworm and nematode adds or subtracts from the vegetation of the area, and what is the total effect of their combined impact. In the numerous studies of grasslands now being conducted because of the value of such areas in soil conservation, no more fruitful project is open, and the failure to include such records of the wild animal life of pastures and meadows is sure to result in a seriously distorted picture.

"An Ecological and Grazing Capacity Study of the Native Grass Pastures in Southern Alberta, Saskatchewan and Manitoba"[3] mentions not a single insect, yet it is preposterous to suppose that no grasshopper disputed with the domestic live stock as to which should eat the grass of these Canadian pastures. "Pastures of Puerto Rico and Their Relation to Soil Conservation"[4] also says not a word of the insects that feed on the pasture grasses of Puerto Rico. Admittedly, however, it does not leave out all mention of insects, for concerning the weed "botoncillo" it states: "It is host plant for the beneficial wasp *Larra americana,* which is a parasite on changas or mole crickets." Reassuring as it may seem to have one's pet parasite introduction project[5] thus signalized for mention, it raises the disturbing suspicion that this may be only the doubtful reward of undue propaganda.

Dr. Herbert Osborn has written an entire book about "Meadow and Pasture Insects" of North America. In the tropics, as elsewhere, the effect of insect life in grasslands may be conspicuous, and is especially obvious when an attempt is made to replace native grasses. The Agricultural Experiment Station at Mayaguez has reported[6] the susceptibility of Java grass, *Polytrias amaura,* to the attack of the chinch bug, but nevertheless it was planted at one of the naval bases in a region of Puerto Rico where chinch bugs are notably scarce on all native grasses. Despite a rainfall normally excessive for chinch bugs, the favorable factor of a very susceptible grass enabled them to become so abundant as to kill the grass in large patches, and render the entire lawn so yellow as to contrast unfavorably with the standardized dirty green camouflage of the buildings. At an army post in

[1] *Ecological Monographs,* 7 (1): 1–90, January, 1937.

[2] See Bibliography, *Bull. Chicago Acad. Sci.,* 6 (4): 63–124, August, 1941.

[3] Tech. Bull. No. 44, Dominion Experiment Station, Swift Current, Saskatchewan, September, 1942.

[4] Misc. Pub. No. 513, U. S. Department of Agriculture, May, 1943.

[5] *Jour. Econ. Ent.,* 34 (1): 53–6, April, 1941.

[6] Report Puerto Rico Agricultural Station, 1936.

Puerto Rico, the planted Bermuda grass was being eaten by changas, *Scapteriscus vicinus* Scudder, although just outside the post, the native gramma grass, *Stenotaphrum secundatum,* flourished with undiminished vigor.

It should not be thought, however, that gramma grass, or any other native grass for that matter, will survive insect attacks under all conditions. Indeed, when supposedly ideal conditions are being artificially supplied for the grass, these may be even more favorable for some particular insect pest. Thus, a circle of yellow gramma grass surrounding the head of an underground sprinkler system was found to mark the limits of an exceptional abundance of a leafhopper, *Kolla fasciata* Walker, present in only normal numbers elsewhere on a lawn near Aguadilla, Puerto Rico.[7] Naturally, also, native vegetation has specific native pests, and large areas of gramma grass may have all the blades eaten down to the sprawling stalks by the little green Pyralid caterpillars of *Psara phaeopteralis* Guenée. These are only a few of the more obvious examples of the effect produced by specific members of the wild animal life of grasslands, but are ample to illustrate the necessity for including them in all ecological studies of pastures and meadows if these are to be considered at all complete.

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[7] *Jour. Econ. Ent.*, 33 (3): 584, February, 1940.

PROPER CREDIT FOR DISCOVERY OF "A RELATIONSHIP BETWEEN DENTAL CARIES AND SALIVA"

IN the March 31, 1944, issue of SCIENCE, Turner and Crane[1] report that they have discovered "a clear relationship . . . between the rate of starch hydrolysis by saliva and the incidence of caries in the individual." The note gives the impression that the finding is new, as indicated by the part quoted here and the absence of any reference to other work on this subject. Therefore, attention should be called to the fact that in 1941 Florestano, Faber and James,[2] using a much larger number of subjects, discovered and reported essentially the same results and conclusions. Consequently, credit for the finding should go to the latter group of workers.

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SCIENTIFIC BOOKS

PLANT VIRUSES

Plant Viruses and Virus Diseases. By F. C. BAWDEN. Second edition. xi + 294 pp. Waltham, Mass., Chronica Botanica Company. 1943. $4.75.

THE book represents an attempt to describe and correlate advances that have been made in the study of plant viruses during the last decade. It deals largely with less than a dozen viruses whose chemical and physical properties have been studied somewhat intensively. Such emphasis on the chemical and physical phases of virus work is perhaps justified, since it is in this field that plant virus research has made remarkable advances in recent years, but I suspect that most plant pathologists would prefer a book discussing virus diseases more broadly. On the whole the book is unusually well written and well illustrated. Biochemical and biophysical phases of plant virus research, especially, are presented accurately and entertainingly, although some descriptions of chemical methods seem unnecessarily long and detailed.

It is unfortunate that in a book of such excellence there should be some serious errors. Chapter 5, which the author states needed extensive alterations in the preparation of a second edition because of the growth of knowledge regarding the relationships between viruses and their insect vectors, may be cited in this connection. In discussing the latent period of viruses in insect vectors the author states on page 76 that the latent period "seems to start from the time the vectors leave the infected plant rather than from the start of feeding on it." The reviewer knows of no evidence anywhere in plant virus literature to support this statement. In discussing such viruses as aster yellows, whose vectors have prolonged latent periods, he states that "in published work there is no indication that vectors can ever infect healthy plants immediately after leaving infected ones." As a matter of fact such cases are reported in the literature. In discussing Black's evidence that the virus of aster yellows multiplies in the vector *Cicadula sexnotata* on page 80 he states, "it is noticeable that the number of successful inoculations is usually greater if the extracts of macerated insects are diluted 1/1000 than if diluted 1/100 or 1/10." This statement is misleading because Black's data do not indicate that dilutions at 1/1000 give more transmissions than dilutions at 1/100 or 1/10. Perhaps the most unsatisfactory section in the chapter is that dealing with work by Fukushi. The author cites the same two papers, published in 1934 and 1935, that were referred to in the first edition and makes essentially the same arguments against Fukushi's evidence that rice stunt virus multiplies in the vector. In papers published in 1939 and

[1] N. C. Turner and E. M. Crane, SCIENCE, 99: 262, 1944.
[2] H. J. Florestano, J. E. Faber and L. H. James, *Jour. Am. Dental Assoc.*, 28: 1799–1803, 1941.